

## THE WEATHER OF THE MONTH.

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The statistical aspects of the weather of the month are presented in the tables which form the closing part of this REVIEW. Table I in particular contains a variety of details from which the reader may select those most interesting to himself. The numerical values in the tables have been generalized in a number of cases, the results appearing on Charts Nos. III to VIII, inclusive.

## PRESSURE AND WIND.

*Normal conditions.*—The geographic distribution of normal barometric readings at sea level and under local gravity for May is shown by Chart VI of the MONTHLY WEATHER REVIEW for May, 1898.

In May as compared with April there is usually a decrease of pressure over the United States and Canada, amounting on the average to 0.05 inch. Pressure is lowest (29.80) over Arizona and contiguous portions of the Southwest, and highest (30.00) on the Pacific and Atlantic coasts.

In May the general tendency of the winds, with few exceptions, is to blow toward the center of the continent. Southeasterly winds prevail over Texas and northward for some distance on the plains. Southwesterly winds prevail in the lower Lake Region and New England.

*The current month.*—The configuration of the isobars on the chart of mean pressure for the current month presents no features of special interest. Pressure was below normal in all sections save eastern Maine, New Brunswick, and Nova Scotia, the northeastern slope of the Rocky Mountains, the upper Missouri Valley, Manitoba, Assiniboia, and the southern portion of Alberta.

## TEMPERATURE OF THE AIR.

*Normal conditions.*—The normal mean temperature of the air in the United States in May varies from about 79° at Key West, 75° at Jacksonville, 75° at New Orleans, 76° at Galveston, 60° at San Diego, to 48° at Eastport, 55° at Burlington, 54° at Buffalo, 58° at Detroit, 48° at Duluth, 52° at St. Vincent, 53° at Havre, 57° at Spokane, and 55° at Seattle, on Puget Sound. The warmest regions now are the lower Rio Grande Valley and southwestern Arizona, including a portion of the desert region of California. The seacoast is cooler than the interior on corresponding parallels. The coldest portion of the United States is the region about Lake Superior.

In studying the distribution of monthly mean temperatures it will be found very helpful to consult the charts at the end of this REVIEW, especially No. VI, Surface Temperatures, Maximum, Minimum, and Mean. This chart gives a very good idea of the variations of temperature with latitude and longitude, and also of the distribution of normal surface temperatures. Chart VI for any month will differ from a normal chart merely in the displacement or bending of the isotherms northward or southward according as the temperature of the particular locality is above or below the normal for the place and season.

*The current month.*—It will be recalled that April, 1898, was considerably cooler than usual. The region of relatively high temperature for that month, included Nevada, western Utah, southern Idaho, and Arizona; the regions of abnormally low temperature included the lower Mississippi Valley, Alabama, northwestern Georgia, and some portions of North Carolina, Virginia, West Virginia, Kentucky, and Tennessee. For the current month temperature was below normal in New

England, eastern New York, Pennsylvania, New Jersey, and Delaware. Elsewhere east of the one-hundredth meridian the temperature was normal, or slightly above, the greatest excess being in eastern Tennessee, northern Georgia, and the western portions of North Carolina and South Carolina. The average daily temperature was in excess by about 3° over that area. The weather was cloudy and wet throughout the Rocky Mountain and Plateau regions, and the temperature was below normal, except in the extreme northwestern corner of Washington. Deficits of 3° and over in daily means were recorded in southern Wyoming, northwestern Colorado, and a portion of northeastern Utah.

The lowest temperature registered at any station was 8° above zero at Lake Moraine and Longs Peak, Colo., in the mountain region of that State. Temperatures below freezing were recorded generally throughout the elevated portions of West Virginia, Pennsylvania, also in western New York, throughout northern Michigan, the Lake Superior region, northern Wisconsin, North Dakota, and portions of South Dakota, and quite generally throughout the Rocky Mountain and Plateau regions.

The maximum temperature of the month was recorded in the Valley of the Colorado River in Arizona. Temperatures of 105° and over were also recorded in the lower Rio Grande Valley. There was also a small area in Georgia and South Carolina over which temperatures exceeding 100° were recorded. In the mountain regions of Colorado and Utah maximum temperatures varied from 80° to 85°.

The distribution of the observed monthly mean temperature of the air is shown by red lines (isotherms) on Chart VI. This chart also shows the maximum and the minimum temperatures, the former by broken and the latter by dotted lines. As will be noticed, these lines have been drawn over the Rocky Mountain Plateau region, although the temperatures have not been reduced to sea level; the isotherms relate, therefore, to the average surface of the country in the neighborhood of the various observers, and as such must differ greatly from the sea-level isotherms of Chart IV.

The average temperatures of the respective geographic districts, the departures from the normal of the current month and from the general mean since the first of the year, are presented in the table below for convenience of reference:

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England .....	10	52.8	- 1.1	+ 8.3	+ 1.7
Middle Atlantic .....	12	61.0	- 0.5	+ 3.5	+ 1.7
South Atlantic .....	10	72.2	+ 1.9	+ 5.5	+ 1.1
Florida Peninsula .....	7	76.7	+ 0.9	+ 0.8	+ 0.2
East Gulf .....	7	74.7	+ 1.8	+ 3.4	+ 0.7
West Gulf .....	7	74.4	+ 1.8	+ 9.8	+ 2.0
Ohio Valley and Tennessee .....	12	67.0	+ 2.0	+ 9.5	+ 1.9
Lower Lake .....	8	57.8	+ 1.1	+ 15.9	+ 3.2
Upper Lake .....	9	53.2	+ 1.6	+ 18.9	+ 3.8
North Dakota .....	7	53.2	+ 0.1	+ 25.1	+ 5.0
Upper Mississippi .....	11	62.2	+ 0.8	+ 15.2	+ 3.0
Missouri Valley .....	10	61.0	+ 0.4	+ 17.6	+ 3.5
Northern Slope .....	7	51.6	- 1.7	+ 8.0	+ 1.6
Middle Slope .....	6	61.1	- 0.9	+ 8.0	+ 1.6
Southern Slope .....	5	68.7	- 0.1	+ 9.0	+ 1.8
Southern Plateau .....	13	64.4	- 2.7	- 0.5	- 0.1
Middle Plateau .....	9	52.6	- 3.5	- 8.4	- 1.7
Northern Plateau .....	11	54.2	- 1.8	+ 4.5	+ 0.9
North Pacific .....	9	54.1	+ 0.4	+ 3.9	+ 0.8
Middle Pacific .....	5	55.1	- 3.3	- 5.4	- 1.1
South Pacific .....	4	60.2	- 2.2	- 1.1	- 0.2

*In Canada.*—Prof. R. F. Stupart says:

In southern Alberta, western Assiniboia, and the greater portion of Saskatchewan, the mean temperature was average or slightly below, but in all other portions of Canada it was above the average, except along the Nova Scotian coast, where the average was just maintained. The excess of average was particularly marked in northern Ontario and over the greater portion of Quebec and New Brunswick. Parry Sound recorded 5° above the average, Rockliffe and Quebec 4° above, Sault Ste. Marie, Toronto, Chatham, and New Brunswick 3° above the average.

## PRECIPITATION.

*Normal conditions.*—Heavy precipitation in May occurs chiefly in northeastern Texas, Arkansas, the lower Mississippi Valley, Tennessee, and portions of Georgia, and generally throughout the Atlantic seaboard as far north as the southern coast of New England. Heavy precipitation also occurs in May on a narrow strip of the coast of Washington and Oregon. The regions of moderate precipitation (2 to 4 inches) are somewhat larger in extent than for the preceding month. The plains region, from about the one hundred and third meridian eastward, has now a normal rainfall of 2 inches. There is also a considerable area in western Montana, extending westward through Idaho and southward through a portion of Wyoming which has an average rainfall of over 2 inches. The regions of scant precipitation include, as before, the greater part of New Mexico, southwestern Colorado, southern Utah, Arizona, Nevada, and southern California.

*The current month.*—May, 1898, must be classed as a month of more than the usual amount of rainfall, the rainfall of western Kansas, in particular, being very heavy. Throughout the entire plains region and the Mississippi Valley north of Memphis more than the usual amount of rain fell, and this is true of the Plateau region and the Pacific coast, save a narrow strip of western Washington and Oregon and northwestern California. More than the usual amount of rain fell on the Atlantic coast from Massachusetts southward to North Carolina. It is worthy of note that, following a protracted dry spell in California and the Plateau region, heavy rains fell throughout a large part of that region, although the rainy season was almost at an end.

The distribution of precipitation was somewhat irregular, as may be seen by an examination of Chart III. In the great wheat and corn regions of the interior the amount averaged from 2 to 4 inches; in some portions of Missouri, Kansas, and Nebraska from 4 to 6 inches.

*Average precipitation and departures from the normal.*

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		<i>Inches.</i>		<i>Inches.</i>	<i>Inches.</i>
New England .....	10	4.91	136	+1.30	+ 3.60
Middle Atlantic .....	12	5.04	138	+1.40	+ 1.50
South Atlantic .....	10	2.34	58	-1.70	- 8.50
Florida Peninsula .....	7	1.61	39	-2.50	- 8.50
East Gulf .....	7	0.67	16	-3.40	-10.90
West Gulf .....	7	3.42	77	-1.00	- 3.00
Ohio Valley and Tennessee .....	12	3.38	87	-0.50	+ 0.30
Lower Lake .....	8	2.62	77	-0.80	+ 0.30
Upper Lake .....	9	2.59	76	-0.80	+ 0.10
North Dakota .....	7	2.64	113	+0.30	- 0.40
Upper Mississippi .....	11	5.25	127	+1.10	+ 4.40
Missouri Valley .....	10	5.52	128	+1.20	+ 2.00
Northern Slope .....	7	3.67	155	+1.30	+ 0.70
Middle Slope .....	6	6.62	163	+3.00	+ 3.50
Southern Slope .....	6	3.99	82	-0.90	+ 1.30
Southern Plateau .....	13	0.96	173	+0.40	- 0.50
Middle Plateau .....	9	2.44	235	+1.40	- 0.70
Northern Plateau .....	11	2.03	133	+0.50	- 1.90
North Pacific .....	9	1.87	70	-0.80	- 1.10
Middle Pacific .....	5	2.13	131	+0.50	- 8.00
South Pacific .....	4	1.06	294	-0.70	- 5.00

The rainfall at Dodge City, Kans., was over 10 inches, an amount greater than the combined rainfall of the same month during the last six years. Attention is called to the fact that the rainfall of 1897 in western Kansas and adjoining regions was plentiful. The rainfall for the current month in this region is likewise greatly in excess of the normal, thus exemplifying the principle that years of abundant rainfall are quite likely to follow each other in succession.

There was a general deficiency in rainfall in the Gulf and South Atlantic States. The drought in Florida continued throughout the month, save at Key West, where the rainfall was about normal. Deficiencies of about 3 inches were recorded in Alabama, lower Mississippi, and Louisiana. There was also a slight deficiency of rainfall in the lower Lake region, including a part of northern Indiana. The rainfall of the eastern Gulf States was less than 20 per cent of the normal, something almost unprecedented for that region.

*In Canada.*—Professor Stupart says:

During the month of May the rainfall was above the average over the more northern portions of Ontario and Quebec, and also locally in the western portion of Alberta, but the excess was nowhere very marked. In all the remaining parts of Canada it was below the average, except at one or two isolated spots, where the excess above the average was due apparently to local thunderstorms. The deficiency was decidedly pronounced over the greater portion of the Territories and Manitoba, the rainfall in some places being almost *nil*. Edmonton was 1.3 inch below the average, and Winnipeg 1.5 inch below. Throughout the Maritime Provinces, also, the rainfall was very considerably below the usual amount. Halifax was 2.0 inches, Sydney 2.5 inches, and St. John 2.4 inches below the average.

## SNOWFALL.

The total snowfall for the current month is given in Tables I and II, and its geographic distribution is shown on Chart VIII. The snowfall of the month was confined principally to the Rocky Mountain region. The snowfall of the Sierra Nevada was very much less than in former years. There was also a rather unusual snowfall in southern Indiana, southwestern Ohio, and northern Kentucky. Snow fell in this region on the 6th heavy enough to break the growing wheat at the joints. It melted soon after falling. This is a case of heavy local snows in the middle of a region of higher temperature, with surface temperatures above the freezing point in all cases.

*The snow on the ground at end of month.*—There was no snow on the ground at the end of the month at reporting stations.

## HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 14, 30. Arizona, 2, 3, 4. Arkansas, 1, 2, 4, 12, 13, 20, 21. California, 12, 28, 30, 31. Colorado, 1, 2, 3, 4, 6, 7, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24, 25, 28, 30, 31. Connecticut, 7, 8. Delaware, 16. Florida, 18, 25. Georgia, 11, 14, 15, 18, 22, 30. Idaho, 2, 3, 4, 6, 7, 12, 17, 18, 19, 20, 23, 24, 28, 29, 30, 31. Illinois, 18, 19, 27, 29. Indiana, 5, 10, 11, 15, 18, 19, 21. Indian Territory, 1, 2, 4, 27. Iowa, 4, 6, 9, 10, 14, 17, 18, 19, 20, 21, 24, 26, 29, 31. Kansas, 5, 6, 11, 15, 20, 22, 28, 29, 30. Louisiana, 27. Maryland, 8, 10, 11, 12, 16, 24. Michigan, 2, 4, 9, 10, 18, 19, 21. Minnesota, 18, 25, 26, 31. Mississippi, 2, 24, 30. Missouri, 1, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 27, 28, 29, 31. Montana, 3, 12, 15, 16, 17, 18, 24, 30. Nebraska, 1, 14, 17, 19, 20, 21, 23, 25, 26, 27, 28, 31. Nevada, 2, 3, 4, 6, 7, 13, 14, 16, 17, 18, 19, 22, 24, 27, 29. New Hampshire, 14, 17. New Jersey, 8, 13, 16, 24. New Mexico, 7, 8, 12, 23, 31. New York, 4, 8, 11, 19. North Carolina, 5, 6, 11, 12, 15, 18, 22, 25, 26, 28, 29, 30. Ohio, 2, 5, 6, 11, 15, 16, 18, 19, 21, 28. Oklahoma, 1, 4, 15, 31. Oregon, 21, 22, 28, 29, 30, 31. Pennsylvania, 8, 10, 11, 19, 24. South Carolina, 6, 11, 15, 18, 19, 23, 25. South Dakota, 11, 17, 20, 24, 25. Tennessee, 5, 6, 12, 14, 15, 16, 22, 25, 28, 29, 30. Texas, 1, 2, 3, 4, 5, 18, 19, 20, 24, 27, 29, 30, 31. Utah, 1, 2, 3, 7, 16, 18, 19, 20.

Vermont, 13. Virginia, 5, 6, 8, 12, 15, 16, 17, 19, 21, 22, 24, 27, 28, 30. Washington, 17, 26, 28, 29, 30. West Virginia, 6, 7, 12, 15, 19, 21, 22, 23, 29. Wisconsin, 18, 21, 26. Wyoming, 11, 12, 13, 14, 15, 23, 24, 30.

## SLEET.

The following are the dates on which sleet fell in the respective States:

California, 1, 6, 19. Connecticut, 8. Illinois, 5. Massachusetts, 8. Michigan, 5. Nevada, 1, 2, 3, 7, 15, 16, 17, 18, 23, 27. New York, 6. Rhode Island, 8. South Dakota, 11.

## HUMIDITY.

The humidity observations of the Weather Bureau are divided into two series; the first or tridaily series began in 1871 and ended with 1887; the second or twice-daily series is continuous from 1888 to the present time.

The monthly means of the second or present series are based upon observations of the whirled psychrometer at 8 a. m. and 8 p. m., seventy-fifth meridian time, which corresponds to 5 a. m. and 5 p. m., Pacific; 6 a. m. and 6 p. m., Mountain; and 7 a. m. and 7 p. m., Central standard time.

Mean values computed from the first series are naturally not directly comparable with those of the second. In general the means of the first series are lower than those of the second, since they include an observation in the afternoon when the relative humidity of the air is near the minimum of the day. At stations in the western plateau region, however, the converse holds good, the means of the second series being lower than those of the first by amounts ranging from 0 to 10 per cent on the average of the year.

In the present state of knowledge respecting the diurnal variation in the moisture of the air, we are scarcely warranted in combining the two series in a general mean.

*The current month.*—The variations in relative humidity during the current month are greater than have been noticed since the beginning of the year. The relative humidity of the Plateau region was unusually high, as was also the case over the middle slope, the northern slope, and the Missouri Valley. The regions of low relative humidity were the Florida Peninsula, the east Gulf, and the north Pacific coast. There was, as might be expected, a fair agreement between the three elements, humidity, cloudiness, and rainfall.

*Average relative humidity and departures from the normal.*

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England .....	80	+ 2	Missouri Valley .....	70	+ 5
Middle Atlantic .....	77	+ 6	Northern Slope .....	62	+ 5
South Atlantic .....	73	- 1	Middle Slope .....	68	+ 8
Florida Peninsula .....	72	- 5	Southern Slope .....	58	0
East Gulf .....	67	- 5	Southern Plateau .....	29	- 1
West Gulf .....	75	+ 2	Middle Plateau .....	56	+ 11
Ohio Valley and Tennessee .....	67	- 1	Northern Plateau .....	56	- 2
Lower Lake .....	72	+ 2	North Pacific Coast .....	72	- 6
Upper Lake .....	74	+ 2	Middle Pacific Coast .....	72	0
North Dakota .....	61	- 3	South Pacific Coast .....	68	0
Upper Mississippi Valley .....	72	+ 5			

In using the table by means of which the amount of moisture in the air is computed from the readings of the wet and dry bulb thermometers, the pressure argument has almost always been neglected, an omission that has little significance except for low temperatures and at high stations, such as Santa Fe, El Paso, Cheyenne, and a few others. The failure to apply a correction for the influence of the prevailing pressure on the psychrometer has the effect of making the monthly means of relative humidity at high-level stations too small by quantities ranging from 5 to 10 per cent. In the application of the monthly averages of the above table, or those of individual stations in Table I, to special inquiries, whether in the

departments of biology, climatology, or sanitary science, this fact should be kept in mind. It should also be remembered that the hours at which observations in the Rocky Mountain Plateau region are made, viz, at 5 or 6 local mean time, morning and afternoon, give approximately the maximum and minimum values for the day; probably the means of such hours approach more nearly the true mean of the month than is the case on the Atlantic seaboard and in the seventy-fifth meridian time belt.

## WIND.

*High winds, local storms, and tornadoes.*—The current month will pass into history as one memorable on account of the number and violence of tornadoes that devastated portions of Iowa, Illinois, and Wisconsin. A period of unusual violence began on the 17th, continuing on the 18th, 19th, and 20th. Charts IX and X show the weather conditions that prevailed at 8 p. m., seventy-fifth meridian time, May 17 and 18, respectively. Dotted lines show the approximate position of tornadoes that occurred on those dates. It is to be noted that tornadic activity began about 6 p. m. of the 17th almost coincidentally at three widely separated places, viz, in the vicinity of Waynoka, Okla.; in Kingman County, Kans.; and near Riverton, Nebr. These points, it will be observed, are almost identical in longitude. The tornadoes of the 17th were not unusually violent, nor did they persist for a great length of time. The origin was gradually transferred eastward, the last occurrence being noted in Iowa and Missouri shortly after 7 o'clock. Although 13 persons were injured and nearly \$50,000 worth of property was destroyed, no lives were lost on this date.

On the following date tornadoes developed almost simultaneously in Cedar County, Iowa, and Eau Claire County, Wis. Both tornadoes were of the most violent character. The Iowa tornado can be traced well into Carroll County, Ill., a distance of over 50 miles. The Wisconsin tornado can not be tracked the entire distance between the beginning of tornadic activity and the place where destructive violence was last manifested, but there can be no question of the severity of the storm over the last 30 or 35 miles of its course. Farther to the eastward a number of tornadoes developed later in the day at points a little to the southeast of the main track, moving in all cases parallel to the course of the two first named. The fatalities of the day numbered 47. Property valued at more than half a million dollars was totally destroyed, and this does not include the loss to standing timber, orchards, and crops. The tornadoes in all cases moved a little north of east. The rate of movement was generally from 30 to 40 miles per hour.

Tornadic activity was renewed on the 19th in southern Oklahoma, but no serious damage was done. On the following day tornadoes were observed in northern Texas, Kansas, northwestern Arkansas, Missouri, and southwestern Illinois, but they were not especially destructive in any case. The record in detail follows:

*May 1.*—Jerico, Cedar Co., Mo., 11:15 a. m., central time. One killed, 5 injured; path 50 to 100 feet wide; length probably less than 10 miles; property loss about \$3,000; moved northeast.

Mobeetie, Tex., 1:45 a. m., central time. Six killed, 37 injured; path a quarter of a mile wide; probably 30 miles long. Twenty-three buildings destroyed; moved northeast.

Ten miles southeast of Chetopa, Ind. T., 11 a. m., central time. Three persons injured; path narrow; about 15 miles long; property loss about \$1,000; moved east-northeast.

A severe local storm passed over Sapulpa, Ind. T., about 9 a. m., central time. Six buildings were damaged to the extent of \$1,000.

2d.—A severe rain and hail storm passed through Ellis Co., Tex., from northwest to southeast, destroying two buildings in the vicinity of Waxahachie and damaging six others.

3d.—Severe wind and hail storms were reported from the eastern portion of Indian Territory, being most severe at Sallisaw.

5th.—A miniature tornado struck Elkin, N. C., about 4 p. m., eastern time. Three persons were injured; path of great destruction half a mile long; property loss about \$1,000; moved to the southeast.

11th.—Four or five persons were injured and several buildings were destroyed by a severe windstorm 8 miles north of Shawnee, Ind. T. Particulars can not be had. Property loss by windstorm of \$1,000 is reported at Sapulpa, Ind. T.

17th.—6:30 p. m., central time. Had its origin about 3 miles southwest of the village of Waynoka, Okla., latitude,  $36^{\circ} 30'$  north; longitude,  $98^{\circ} 55'$  west, approximately; moved northeasterly, passing through the village and open country beyond, and was last seen near Alva, about 20 miles from its origin; no lives lost; property loss small, about \$600.

6 p. m., central time. Had its origin in Gove Township, southeastern corner of Pratt County, Kans.; latitude,  $37^{\circ} 30'$  north; longitude,  $98^{\circ} 30'$  west, approximately; moved northeasterly through the open country, destroying a few farm houses. Struck the southern half of the town of Cunningham, Kans., totally destroying about 20 buildings and partially wrecking a number of others; no lives lost; property loss probably \$50,000. An iron safe weighing 1,700 pounds was carried 53 yards north-northeast passing over the cellar of a wrecked hotel.

5 p. m., central time. Supposed to have originated on the northern border of Kansas, 12 miles southwest of Riverton, Nebr., near which place it passed at 5:30 p. m., moving in a northeasterly course. Several persons were injured in Franklin County. The property loss in the county was estimated at \$10,000; the loss near Bladen, in Webster County, 20 miles northeast of Riverton, was estimated at \$3,000. A second tornado is believed to have formed to the northeast of Riverton probably as early as 5 p. m., since the tornado that caused the destruction near Braden passed the latter place at 5:20 p. m., central time.

A third tornado passed over the eastern edge of Kearney County, Nebr., crossing into Hall County near the little town of Wood River. Two persons were injured, and the property loss is said to have been \$20,000. Severe windstorms prevailed generally throughout central and eastern Nebraska on the afternoon of the 17th. Some destruction of property was reported from Albion and several persons were injured by falling walls.

Tornadic action was also reported about 8 miles northwest of Neligh, Antelope Co., Nebr.

A minor tornado passed through a portion of Buchanan County, Mo., about 10 p. m., central time. The destruction was confined principally to orchards, outbuildings, and timber. No persons were injured. Approximate position of tornado: Latitude,  $39^{\circ} 35'$ ; longitude,  $94^{\circ} 45'$ .

A tornado formed in the southeastern part of Taylor County, Iowa, about 5 p. m., central time, and disappeared in the adjoining county of Ringgold. Seven persons were injured; property loss estimated at \$5,000; path was about 40 rods wide; probably 25 miles long. Approximate position of central point: Latitude,  $40^{\circ} 45'$ ; longitude,  $94^{\circ} 35'$ .

The total casualties for the day were 13 persons injured, with a property loss of \$43,000.

18th.—The Iowa-Illinois tornado had its origin in the northern part of Cedar County, Iowa, about a mile south of the village of Starwood, at 3:20 p. m., central time. It moved east by north through the northern part of the adjoining county of Clinton until within a few miles of the

Mississippi, when it passed into Jackson County, crossing the Mississippi about  $1\frac{1}{2}$  mile south of Sabula at 4:45 p. m. From its origin to where it crossed the Mississippi is about 50 miles as the crow flies. It covered the distance in one hour and twenty-five minutes, or at the rate of 35 miles per hour.

Mr. Thomas Lambert, editor of the Sabula Gazette and a personal witness of the storm, traveled westward from the Mississippi over 33 miles of the storm track. Mr. Lambert is authority for the statement that the funnel cloud was apparently in the air for perhaps a quarter of the way, since there was but slight damage in spots. This fact is of special interest in its bearing upon the life of a tornado. Ordinarily, a tornado does not pursue an uninterrupted course for more than 15 or 20 miles. Indeed, the path of great destruction is generally much less than that distance. In the present case there is undisputed evidence of a severe tornado persisting from 3:20 to 4:45 p. m., and presumptive evidence that it retained its force somewhat longer. The course of the tornado after crossing the Mississippi was as before, viz, east about  $20^{\circ}$  north. Its passage through Carroll County is not as well attested as might be desired. The only report in the county that we have been able to secure is from Mr. M. N. Wertz, voluntary observer near Lanark. Mr. Wertz gives the time of the tornado as 4:45 p. m., the same time, it will be remembered, that the storm was reported as crossing the Mississippi. Mr. C. E. Nicodemus, postmaster, Forreston, Lee County, about 14 miles east-northeast of Lanark, reports the tornado as passing that place at 5:30 p. m., central time. Assuming that the tornado crossed the Mississippi at 4:45 p. m., it must have increased its rate of progression from 35 to 44 miles per hour in order to reach Forreston at the time given.

It is not altogether clear whether the whirling cloud mass was constantly renewed and projected forward in a somewhat tortuous course, or whether a new whirling cloud formed a little ahead of and to the south of the original storm and traveled in a path parallel to the old storm. The question of the identity of the tornado clouds, viewed at widely separated points, is of considerable importance, since were it known that these storms pursued an undeviating course for a given time, it would not be a difficult matter to warn towns and villages directly in their course.

As tending to show that the same general storm, after devastating eastern Iowa, passed through Carroll County, Ill., it may be stated that many light articles, some of which could be identified as belonging to persons in Iowa, were carried 8, 10, and 12 miles to the northward of the storm track and scattered broadcast over the country. The Weather Bureau observer for Lanark, who lives 8 miles from the storm track in the central portion of Carroll County, had his attention first called to the tornado by a piece of shingle falling on his farm. Likewise farmers living 10 miles north of Sabula, on both sides of the Mississippi, picked up numerous light articles that had been carried thither by the storm winds. One remarkable case was the finding at Pearl City, Ill., 12 miles north of the storm track, of a deed belonging to Mr. Marvin Finton, of Maquoketa, Iowa, 45 miles southwest of the city first named.

When the tornado left Forreston, Lee County, Ill., it was moving to the east bearing a little to the north. Evidence of its farther progress is wanting. Adeline, 6 miles south-east of Forreston, however, reports a tornado as passing that place at 5:50 p. m., central time. The cloud seemed to roll forward on a horizontal axis instead of turning with a spiral motion. Stillman Valley, about fifteen miles southeast of Adeline, was visited by a tornado at 6:05 p. m., central time. The storm approached from the southwest, having its origin 25 or 30 miles from that village. It moved mostly through

timber, devastating a strip about 20 rods wide and continued for about 15 miles northeast of Stillman Valley.

A fourth tornado appears to have developed in Bureau County about  $4\frac{1}{2}$  miles northwest of Sheffield. This storm was severe in the neighborhood of Ohio, where about 20 buildings were completely destroyed. It moved thence through a farming community, destroying farm houses and buildings, crossing the Chicago, Burlington and Quincy Railway tracks between Amboy and Shaws, in Lee County. Its course thenceforward can not be traced.

A fifth tornado formed evidently near Sublette, Lee County, and moved northeastward, passing in full view of persons at Compton and Pawpaw, about 6 p. m., central time.

The fatalities in Iowa were as follows: Between Elwood and Delmar, 3; near Delmar, 3; near Riggs, 2; near Preston, 7; total, 15. In Illinois: Carroll County, 3; Ogle County, 11; Lee County, 1; Bureau County, 1; total, 16. The loss to property can not, in the nature of the case, be accurately given. An approximate statement of loss in Iowa fixes the amount at \$150,000; in Illinois, at \$340,000; total in Iowa and Illinois, \$490,000. The above figures are below the estimates made by persons on the ground.

The Iowa tornado had its origin in latitude  $41^{\circ} 50' N.$ , approximately, longitude  $91^{\circ} 10' W.$  It began, as before stated, at 3:20 p. m., central time.

Tornadoes developed in Wisconsin a little later in the afternoon, and it is worthy of notice that the point of origin, viz, in Eau Claire County, is almost identical in longitude with the origin in Iowa. This fact was also noticed on the day previous. Three parallel bands of tornadoes were observed. The first in point of time had its origin, as above stated, in Eau Claire County, between 4 and 5 p. m., central time. It moved northeastward and apparently disappeared in Clark County. The next report of a tornado was received from Abbotsford, in the northeastern corner of Clark County. From Abbotsford to Antigo is 63 miles. The course of the storm between the two places seems to have been well observed. There is a discrepancy, however, between the time given for the storm's appearance at Granite Heights and Antigo. Both observers report the storm as appearing at 6:40 p. m. Since the distance between the two places is about 20 miles, it is possible that one and the same storm did not visit both places. Antigo, where the last damage was done, lies east  $20^{\circ}$  north and 110 miles distant from the point where tornadic action was first observed. There was very great destruction throughout the entire length of the tornado in Marathon County up to the time it crossed the Wisconsin River at Granite Heights. Between that point and Antigo, where 3 persons were killed and between 30 and 40 severely injured, the damage appears to have been slight. A second group of tornadoes originated in Price and Lincoln counties and moved northeastward, disappearing in Oneida County at 6:30 p. m., central time. A third group originated in Dane County a little southwest of Madison and moved northeastward in a comparatively short track, disappearing between 6 and 7 o'clock in the same county. Tornado funnel clouds were observed at various times between 3:30 and 5:30 p. m. by the Weather Bureau observer at Madison.

Sixteen persons were killed in Wisconsin—2 in Eau Claire County, 2 in Oneida County, and 12 in Marathon and Langlade counties. Upward of 100 people were injured.

The property loss in the Dane County tornado was from \$8,000 to \$10,000; Eau Claire County, about \$25,000; Marathon and Langlade counties, probably \$150,000, aside from loss to timber; Oneida County, probably \$25,000, in addition to which from twenty to thirty million feet of timber were blown down.

Loss of life for the day, 47. Property loss, \$700,000, not including timber.

19th.—Tornadic activity was renewed on the 19th at two points in the Indian Territory, viz, Ardmore and Davis. The funnel cloud appeared at Ardmore at 8:15 p. m., central time. Three persons were injured; the property loss was about \$4,000; path of greatest destruction was 50 feet wide and 1 mile long. At Davis, 1 person was killed and several buildings were destroyed. No further particulars obtainable.

20th.—Tornadoes were observed at widely separated points in Texas, Kansas, Arkansas, Missouri, and Illinois.

The first in point of time was observed to the southeast of Salina, Kans. As many as three funnel clouds were seen at one time; these moved to the northeast in a path about 8 miles long, between 3 and 4 p. m., central time. One man was killed and several farm houses destroyed.

A minor tornado moved northeastward near Severy, Kans., about 6 p. m., central time. Twelve persons were injured and the property loss was about \$3,000. The path of great destruction was less than 3 miles long and from 50 to 300 feet wide.

A third tornado was observed at 7 p. m., central time, in Washington County, Ark. Two people were killed and 11 were injured; the property loss was \$15,000, aside from the loss to orchards and timber. The path of the storm was about 80 yards wide and 10 miles long, and it moved at a rate of 32 miles per hour.

A fourth tornado struck Ravenna, Fannin Co., Tex., at 7:30 p. m., central time; two persons slightly injured; property loss in Ravenna, \$8,000; tornado moved northeast; path about 15 miles long, 100 to 300 yards wide.

About 8:30 p. m., central time, a tornado formed in Barry County, Mo., near the Arkansas line. It moved through the central portion of Stone County, through Christian County, and disappeared in Webster County. It is quite probable that the path of great destruction was not continuous throughout these counties. The destruction was confined principally to farm houses and implements, orchards, fences, bridges, etc. Probably as many as 20 dwelling houses and a larger number of barns were destroyed in its course. The loss is estimated at \$20,000.

A minor tornado was observed in Henderson County, Ill., passing near the towns of Raritan and Ellison, about 5 p. m., central time. The tornado cloud evidently touched the earth over but a small portion of its course. The property loss was estimated at \$3,500.

25th.—A tornado passed from the southwest to the northeast corner of Morton County, Kans., latitude  $37^{\circ}$ , longitude  $102^{\circ}$ , destroying buildings and windmills, etc., in its course. Tornadoes rarely occur as far west as the one hundred and second meridian, but this appears to be a very well authenticated case of a storm of considerable violence developing and persisting for some time in this region.

27th.—Near Scandia, Kans., 7 p. m., central time, 2 persons injured; property loss, \$2,500. The tornado cloud lifted and descended at intervals in a path 6 to 8 miles long.

31st.—Dekalb County, Mo. First observed in the western part of the county near Orchid at 4:15 p. m., central time. It passed Fairport, in the north-central portion of the county, at 4:30 p. m. Four persons were killed and 6 were injured. It is estimated that the money loss aggregated fully \$30,000. The length of the path of great destruction was approximately 25 miles. Some minor damage was done in Daviess County in the line of the tornado after leaving Dekalb.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:



*Maximum wind velocities.*

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Amarillo, Tex .....	8	64	w.	Hatteras, N. C .....	30	33	n.w.
Do .....	20	52	w.	Havre, Mont .....	28	33	se.
Do .....	23	56	w.	Huron, S. Dak .....	17	33	se.
Do .....	30	50	sw.	St. Louis, Mo .....	11	33	w.
Block Island, R. I. ....	20	52	ne.	Do .....	17	33	sw.
Fort Canby, Wash .....	21	52	se.	Sioux City, Iowa .....			

**SUNSHINE AND CLOUDINESS.**

The quantity of sunshine, and therefore of heat, received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends upon the absorption by the atmosphere, and varies largely with the distribution of cloudiness. The sunshine is now recorded automatically at 21 regular stations of the Weather Bureau by its photographic and at 47 by its thermal effects. The photographic record sheets show the apparent solar time, but the thermometric records show seventy-fifth meridian time; for convenience the results are all given in Table IX for each hour of local mean time. In order to complete the record of the duration of cloudiness these registers are supplemented by special personal observations of the state of the sky near the sun for an hour after sunrise and before sunset, and the cloudiness for these hours has been added as a correction to the instrumental records, whence there results a complete record of the duration of sunshine from sunrise to sunset.

The average cloudiness of the whole sky is determined by numerous personal observations at all stations during the daytime, and is given in the column "average cloudiness" in Table I; its complement, or percentage of clear sky, is given in the last column of Table IX for the stations at which instrumental self-registers are maintained.

The percentage of clear sky (sunshine) for all of the stations included in Table I, obtained as described in the preceding paragraph, is graphically shown on Chart VII. The regions of cloudy and overcast skies are shown by heavy shading; an absence of shading indicates, of course, the prevalence of clear, sunshiny weather.

The formation of fog and cloud is primarily due to differences of temperature in a relatively thin layer of air next to the earth's surface. The relative position of land and water surfaces often greatly increases the tendency to form areas of cloud and fog. This principle is perhaps better exemplified in the Lake region than elsewhere, although it is of quite general application. The percentage of sunshine on the lee shores of the Lakes is always much less than on the windward shores. Next to the permanent influences that tend to form fog and cloud may be classed the frequency of the passage of cyclonic areas.

*The current month.*—The month was one of bright sunshine in the Southwest and over a considerable portion of the Gulf

States; especially is this true of western Florida, Georgia, and southern Alabama. The sunshine in the Lake region was about normal. There was, however, a very considerable area in the Missouri Valley, westward, including Nebraska, northern Colorado, Wyoming, southern Montana, northern Utah, Idaho, and a portion of Washington and Oregon, over which the sunshine was very much less than usual. The precise limits of this region can readily be seen by examining Chart VII. It will be noted, in connection with this chart, that at no time since the first of the year has there been so little sunshine over so great an extent in the interior of the country.

*Average cloudiness and departures from the normal.*

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England .....	6.6	+1.1	Missouri Valley .....	6.2	+0.8
Middle Atlantic .....	6.2	+1.0	Northern Slope .....	6.5	+1.1
South Atlantic .....	3.6	-0.8	Middle Slope .....	5.4	+0.6
Florida Peninsula .....	2.4	-2.1	Southern Slope .....	4.0	-0.5
East Gulf .....	2.9	-1.4	Southern Plateau .....	2.6	+0.4
West Gulf .....	4.7	-0.2	Middle Plateau .....	5.3	+2.2
Ohio Valley and Tennessee ..	4.7	-0.4	Northern Plateau .....	5.2	-0.4
Lower Lake .....	6.2	+1.0	North Pacific Coast .....	5.2	-0.6
Upper Lake .....	5.2	-0.3	Middle Pacific Coast .....	5.4	+1.2
North Dakota .....	4.4	-0.9	South Pacific Coast .....	4.0	-0.2
Upper Mississippi Valley .....	5.6	+0.4			

**ATMOSPHERIC ELECTRICITY.**

Numerical statistics relative to auroras and thunderstorms are given in Table IX, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

*Thunderstorms.*—The dates on which the number of reports of thunderstorms for the whole country were most numerous were: 19th, 425; 20th, 304; 21st, 281; 18th, 267; 16th, 237; 15th, 212.

Reports were most numerous from Missouri, 370; Ohio, 321; Illinois, 284; North Carolina, 215.

*Auroras.*—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, from the 1st to the 9th.

The greatest number of reports were received for the following dates: 29th, 13; 9th, 11; 15th and 30th, 3.

Reports were most numerous from Wisconsin, 13; North Dakota, 8; Ohio, 7; Minnesota, 4.

*In Canada.*—Auroras were reported as follows: Father Point, 8, 9, 10; Quebec, 30, 31; White River, 4, 30; Minnedosa, 27, 30; Swift Current, 11; Prince Albert, 13, 29.

Thunderstorms were reported as follows: Father Point, 12; Quebec, 20; Montreal, 14, 19, 22; Rockliffe, 11; Toronto, 11, 19, 22, 23; Port Stanley, 3, 11, 19, 20; Saugeen, 11, 19; Parry Sound, 11, 18, 19, 22; Port Arthur, 9; Minnedosa, 25; Qu'Appelle, 24; Swift Current, 23, 30; Calgary, 18; Kamloops, 17, 21; Esquimalt, 26.

**CLIMATE AND CROP SERVICE.**

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following extracts relating to the general weather conditions in the several States and Territories are taken from the monthly reports of the respective sections of the Climate and Crop Service. The name of the section director is given after each summary.

Rainfall is expressed in inches.

REV—2

*Alabama.*—The mean temperature was 73.6°, or 2.6° above normal, the highest was 101°, at Eufaula on the 30th, and the lowest, 33°, at Valleyhead on the 7th. The average precipitation was 0.82, or 3.06 below normal; the greatest monthly amount, 3.05, occurred at River-ton, while none fell at Citronelle and Wilsonville.—*F. P. Chaffee.*

*Arizona.*—The mean temperature was 67.8°; the highest was 109°, at Parker on the 10th and 11th, and the lowest, 23°, at Williams on the 5th. The average precipitation was 0.39; the greatest monthly amount,